Preprocessing Principals

Session 710

Preprocessing Principals

Glenn Bulycz
Sr. Product Manager, QuickTime
bulycz@apple.com

Preprocessing Principals

Ben Waggoner
Principal
Ben Waggoner Digital
ben@benwaggoner.com

Introduction

- This session covers the theory and practice of preprocessing in encoding for web video
- Demonstrations with popular tools
- Useful information for compressionists and designers of video processing tools

What You'll Learn

- What is preprocessing?
- Why preprocessing matters
- Fundamental preprocessing techniques
- Demo using preprocessing in popular Mac tools
- Focus on web delivery
  - Preprocessing typically not needed for DVD

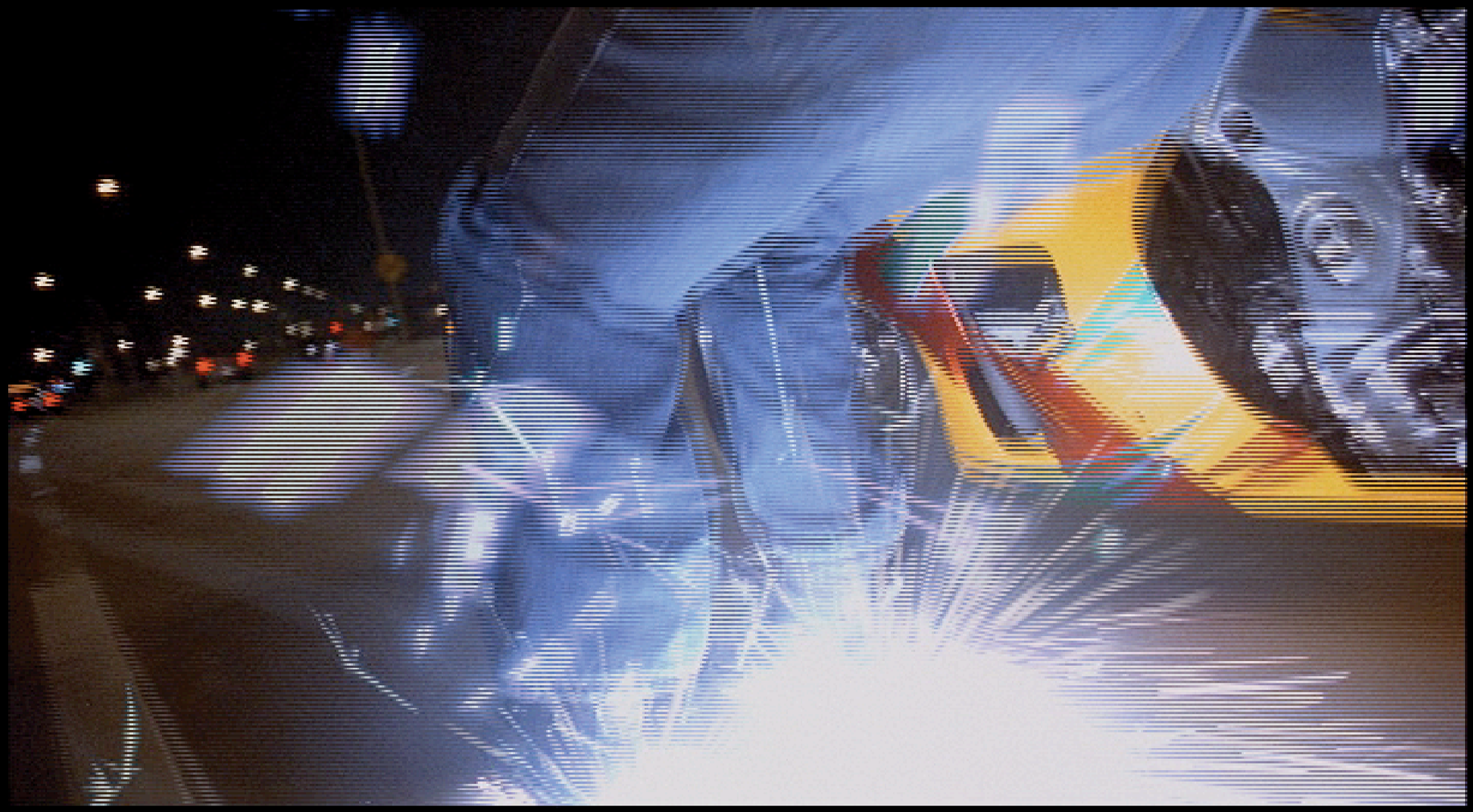
What Is Preprocessing?

- All processing between source frame of video and frame handed to codec
- The most artistic part of compression
- The hardest part of compression
  - (I spend 90% of my labor on preprocessing)

Why Preprocessing Matters

- Maximizes bang for the bit
- Providing optimal version of content to codec
- Making every bit and pixel count

Unprocessed Frame



Same Frame Preprocessed

Unprocessed @ 800 Kbps

Preprocessed @ 800 Kbps

Deinterlacing

- Traditional video has 2 fields per frame: interlaced
- Computer video is shown in order: progressive
- Leaving video interlaced for web codecs is bad
  - Looks stupid
  - Double images of moving objects
  - Very sharp horizontal lines hard to compress
- Progressive content doesn’t need deinterlacing

Deinterlace—Basic Method

- Keeps only the selected field
- Interpolates removed lines
  - Essentially makes source 720x240 bitmap

Adaptive Deinterlacing

- Just deinterlaces moving parts of image
- Effective resolution twice as high for static images
- Can have errors with some content

Inverse Telecine

- Flavor of deinterlacing for NTSC from film source
- Telecine process
  - Film goes at 24fps
  - Going to 60-field video requires 3-2 pulldown
  - Film slowed down 0.1% to 23.976 (to match 29.97 from 30)
  - First frame into 3 fields, next into 2, than 3, than 2, repeating
  - Pattern: 3 progressive, 2 interlaced frames, repeating
- Inverse Telecine
  - Reverses process
  - Restores to full, accurate 23.976 fps
  - Provides perfect, full-height frames (no interlacing)
  - Processing composited film/video difficult for many tools

Crop

- Video monitors do not go to edges
- Computers do
- Crop edge blanking
- Asymmetric okay to cut out noise
- For low resolution, crop to safe area
- Crop letterboxing as well
- If going to 16x16 resolution, can crop to final aspect ratio

The Safe Area

Scaling

- Makes image proper size and shape
- Correct for non-square pixel source
  - 720x480, 720x486, 720x575 all non-square pixel
- Web video does not need to be 4:3!
- Output aspect ratio match aspect ratio of cropped source
  - NOT 360x240 from 720:480
  - 320x240 for 4:3
  - 432x240 for 16:9
- Use high-quality scaling algorithm
  - Bicubic
  - Sine

Goal: Don’t Scale Up

- 720x480 deinterlaced is 720x240
- 720x240 cropped 10% is 648x216
- 648x216 to 320x240 is scaling up vertically
- For 320x240 or higher output
  - Minimize cropping
  - Use adaptive deinterlacer or inverse telecine

Luma Adustment

- Luma is equivalent to brightness
- Luma filters typically Contrast, Brightness, Gamma
- Back in day, compensating for video and computer luma required
- QuickTime now handles color space conversion behind scenes
- Adjusting luma useful to optimize, especially with degraded sources

Brightness and Contrast

- Brightness
  - Lower brightness adds richness
    - Can help make title cards mathematically black
  - Higher generally too noisy
  - Not needed for clean source
- Contrast
  - Back in day, +27 contrast recommended
    - NOT needed for modern codecs
  - Also useful for noisy source
  - Typically add one unit contrast per unit brightness reduced

Gamma

- Gamma controls middle range of brightness
  - No effect on black or white
  - Most effect in middle of range
- Platform differences
  - Macs use 1.8 gamma
  - Video uses 2.2 gamma
  - Windows uses 2.2.–2.5 gamma
  - Used to have to make different versions for Mac, Windows
- 2vuy codecs (MJPEG, MPEG-4) correct to local gamma
- So, gamma correction no longer required
- Useful to make image “brighter” leaving black, white alone

Noise Reduction

- Filters that attempt to remove noise, leave everything else
- Always cause some blurring
- Some tools only apply blur
- Use with caution—can often hurt more than help
- Some tools can do temporal processing (good for grain)

Audio Normalization

- Finds loudest point in audio
- Raises or lowers volume of whole file so loudest point is at specified volume
- Peak loudness too high for some codecs
- -3 dB good for modern codecs

Other Audio Processing

- Compression—reduces dynamic range—good for 3GPP!
- Notch filter—removes specific frequency from audio, generally 60Hz from AC
- Noise removal—takes out repetitive background noise

Demo

http://developer.apple.com/wwdc2003/urls.html

Wrap Up

Roadmap—Wednesday

	Russian Hill	Pacific Heights	Haight/ Ashbury	SOMA
9:00	711 Audio and QuickTime		712 QuickTime for the Web	713 Introduction to QuickTime Interactivity
10:30			714 Large-Scale Webcasting: Macworld Keynote Case Study	715 QuickTime Interactivity Tools
12:00				
2:00	716 Advanced QuickTime Programming Techniques		717 3GP: Myth Versus Reality	718 AppleScript and QuickTime
3:30			719 Administering QuickTime Streaming Server	720 Content Creation for Mobile Phones: Top 10 Success Factors
5:00			721 WiFi and 3G: Let the Games Begin	722 Advanced QuickTime Interactivity

Roadmap—Thursday

	The Mission		Haight/ Ashbury	SOMA
9:00	727 QuickTime Streaming Server Programming		723 The Real Story About MPEG-4 Visual Licensing	724 What's New With QuickTime VR?
10:30			725 QuickTime and Enhanced CDs	726 Cutting-Edge Projects Using QuickTime VR
12:00				
2:00			728 Produce a Listening Party With QuickTime	729 Industrial-Strength Encoding
3:30			FF011 QuickTime Feedback Forum	
5:00				

Roadmap—Friday

	Pacific Heights	The Marina
9:00		
10:30	730 QuickTime Alternative Programming Environments	
12:00		
2:00		731 Internet Application Development: The New Frontier
3:30		
5:00		

Who to Contact

Ben Waggoner
Principal, Ben Waggoner Digital
ben@benwaggoner.com

Guillermo Ortiz
QuickTime Technology Manager
quicktimeman@apple.com

http://developer.apple.com/wwdc2003/urls.html

For More Information

For More Information

Documentation

Compression for Great Digital Video:
Power Tips, Techniques, and Common Sense
http://www.benwaggoner.com/books.htm

General Information
http://www.apple.com/quicktime

Developer Information
http://developer.apple.com/documentation

QuickTime Information
http://developer.apple.com/QuickTime

Do Not Miss!

Lab: QuickTime Content Creation

Meet with QuickTime content experts for daily content specific topics that are of special interest to you. Bring your own media and Powerbook. No appointment is needed—first-come, first-served.

Sacramento Room

Lab: QuickTime Development

Meet with Apple's QuickTime engineers. Each day will emphasize a specific QuickTime development topic. Bring your own code and Powerbook. No appointment is needed—first-come, first-served.

Sacramento Room

Lab Hours

Monday	12:00pm to 6:00pm
Tuesday	9:00am to 6:00pm
Wednesday	9:00am to 6:00pm
Thursday	9:00am to 4:30pm
Friday	9:00am to 6:00pm

Q&A

Glenn Bulycz
Sr. Product Manager, QuickTime
bulycz@apple.com

http://developer.apple.com/wwdc2003/urls.html

WWDC 2003

Worldwide Developers Conference